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(54) Transverse spinal rod connector clip

(57) A device for connecting two elongated spinal rods to one another in a spinal fixation system comprising a clip body including a first portion and a second portion, the first portion of the clip body configured to receive and engage a first elongated spinal rod, the second portion of the clip body having a transverse bore therein for receiving a second elongated spinal rod extending transverse to the first elongated spinal rod; and a locking member dimensioned and configured for mounting in the transverse bore in the second portion of the clip body so as to fix the position of the second elongated spinal rod with respect to the first elongated spinal rod.

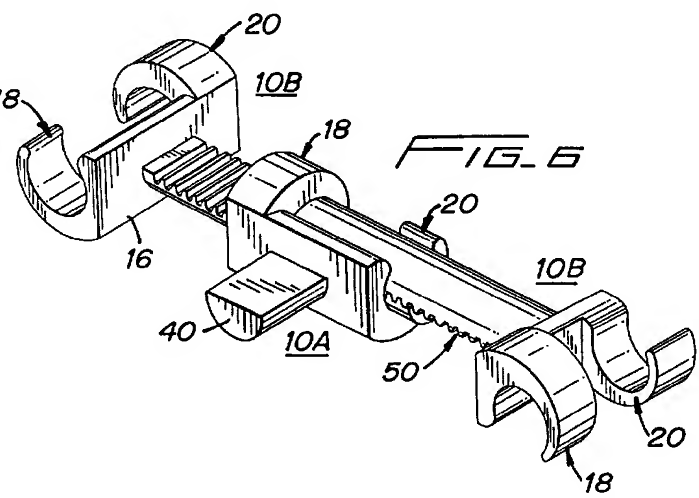

FIG_6

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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to implantable spinal fixation systems for the surgical treatment of spinal disorders. More particularly, this invention relates to a transverse rod connector clip for connecting cylindrical rods to each other.

2. Background of the Invention

For years doctors attempted to restore stability to the spine by fusion (arthrodesis) of the problem area. This treatment yielded marginal results due to the inherently flexible spinal column. Over the past ten years spinal implant systems have been developed to add stability to the spine to enhance the arthrodesis rates. Such systems often include spinal instrumentation having connective structures such as a pair of plates and/or rods which are placed on opposite sides of the portion of the spinal column which is intended to be fused. These spinal systems consist of screws and hooks for segmental attachment to the spine and longitudinal rods connected to screws or hooks. These components provide the necessary stability both in tension and compression yet yield minimal torsional control.

It has been found that when a pair of spinal rods are fastened in parallel on either side of the spinous process, the assembly can be significantly strengthened by using at least one additional rod to horizontally bridge the pair of spinal rods. A cross brace assembly is disclosed in U.S. Pat. No. 5,084,049. Devices such as these commonly consist of a threaded rod for providing the desired lateral support. The threaded rod is fastened to each of the spinal rods by clamps located on each end of the threaded rod. However, this configuration is bulky and can cause irritation of the patient's back muscles and other tissue which might rub against the device. A cross brace assembly that fits closer to the spine, preferably in the same general plane as the vertical spinal rods, would reduce the complications associated with bulkier devices.

Most existing transverse connectors consist of rods, plates, and bars linked to the longitudinal rods by coupling mechanisms with set screws, nuts, or a combination of each. These connectors require several components and instruments to build the constructs. Each additional component or instrument required to assemble the connectors adds to the "fiddle factor" of the surgical technique. Examples of these transverse connectors indude Tranverse Link Device (DLT) and Crosslink manufactured by Sofamor Danck, Trans-Connector manufactured by Synthes, and Modular Cross Connector and Transverse Rod Connector (TRC) manufactured by AcroMed.

Telescopic rod to rod couplers for use in a spinal implant systems have also been described. Prior to the locking member being engaged, the telescoping sections may be easily slid past their extremes and out of engagement with one another. While this is a convenient method of connecting and disconnecting the coupler sections, it can be inconvenient during surgery if the sections accidentally disengage. U.S. Patent No. 5,275,600 describes a telescopic rod to rod coupler in which the telescopic rod sections are assembled together using a 180 degree twisting motion. This is designed to minimize the risk of the rod sections accidentally disconnecting during the implant procedure.

Presently available spinal fixation systems frequently require careful alignment of the hardware used to connect the components of the spinal instrumentation with each other. A need has thus arisen for improved rod connector to transversely connect spinal rods without requiring additional manipulation of the spinal instrumentation and to minimize the use of pedicle screws while at the same time reducing requirements to assemble small pieces of hardware during the surgical procedure.

SUMMARY OF THE INVENTION

The present invention is directed to transverse connector clips for connecting cylindrical rods in spinal fixation systems. The transverse connector clips of the present invention have a clip body with a first side and a second side. The first side of the clip body has a longitudinal axis and a pair of mirror image hemi-cylindrical shells. The hemi-cylindrical shells each have an inner diameter that is slightly smaller than the outer diameter of the cylindrical spinal rod. The clip body is shaped to allow the hemi-cylindrical shells to spread around the cylindrical rod when it is inserted between the hemi-cylindrical shells. The deflection of the hemi-cylindrical shells and the inner shell diameter allow the clip body to securely clamp on the cylindrical spinal rod, placing the inserted cylindrical rod at a 90° angle relative to the longitudinal axis of the clip body

The transverse connector clips of the present invention can be used to transversely connect spinal rods without requiring additional manipulation of the spinal instrumentation. Because the clips of the present invention do not require any additional locking mechanism, they reduce the assembly of small pieces of hardware during the surgical procedure.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a top perspective view of one embodiment of a transverse connector clip of the present invention;

Figure 2 is a perspective view of one embodiment of the transverse connector clip of the present invention with a short, laterally extending bar;

Figure 3 is a top perspective view of another embodiment of a transverse connector clip of the present invention with a laterally extending bar having a plurality of vertical teeth;

Figure 4 is a bottom perspective view of the invention clip of Fig. 3;

Figure 5 is a perspective view of a pair of the connecting transverse connector clips of Figure 3;

Figure 6 is a perspective view of the clip of Fig. 2 securing the transverse connector clips of Fig. 5;

Figure 7 is a schematic view of the present invention connected to spinal rods implanted in a human spine and illustrating the method of assembly;

Figure 8 is a top perspective view an another embodiment of the present invention;

Figure 9 is a bottom perspective view of the invention of Fig. 8;

Figure 10 is perspective view of the invention of Fig. 8 illustrating the connecting mechanism of the connector clip;

Figure 11 is a perspective view of the invention of Fig. 8 connected to the ends of an T-bar;

Figure 12 is a perspective view of an another embodiment of the present invention illustrating the method of assembly of two connector dips having laterally extending tapered bars connected together with a tapered sleeve;

Figure 13 is a perspective view of the invention of Fig. 12 illustrating a range of lateral adjustment between the two clips;

Figure 14 is a schematic view of the invention of Fig. 13 connected to spinal rods implanted in a human spine and illustrating the method of assembly;

Figure 15 is a perspective view of another embodiment of the present invention illustrating the method of assembly; and

Figure 16 is a perspective view of the assembled invention of Fig. 15.

DETAILED DESCRIPTION OF INVENTION

The present invention is directed to a transverse connector clip 10 and assemblies used in spinal fixation systems. Spinal fixation systems typically include spinal instrumentation having connective structures such as a pair of plates and/or rods which are placed on opposite sides of the spinal column near vertebrae that are intended to be fused. These spinal systems consist of screws and hooks for segmental attachment to the spine and longitudinal rods connected to screws or hooks. These components provide the necessary stability both in tension and compression yet yield minimal torsional control. In addition, it has been found that when a pair of spinal rods are fastened in parallel on either side of the spinous process, the assembly can be significantly strengthened by using at least one additional rod to horizontally bridge the pair of spinal rods.

The transverse connector clips 10 of the present invention consist of a component with a means to clip the device on a spinal or cylindrical rod 11 and a component with a means to link two rod connectors together laterally. Transverse connector clip 10 concept consists of a clip body 12 with a first side 14 and a second side 16 (Figure 1). On first side 14 are two, mirror image hemi-cylindrical shells 18 and 20. These two, mirror image hemi-cylindrical shells 18 and 20 have an inner surface 24 that defines a rod bore 26 through which the cylindrical rod 11 can extend. Rod bore 26 has an inner diameter 22 that is designed to be slightly smaller than the outer diameter of the cylindrical rod 11 it will receive. Top surface 28 of the hemi-cylindrical shells 18 and 20 defines an outer diameter 30.

It should be noted that the two, mirror image hemi-cylindrical shells 18 and 20 can be connected to the first side 14 of clip body 12 as shown in clip 10 A of Figure 2 or in mirror image relationship as shown in clip 10A of Figure 6.

Clip body 12 is placed on the cylindrical rod 11 at 90 degrees and turned so that the hemi-cylindrical shells 18 and 20 spread around the rod 11. The deflection of the hemi-cylindrical shells 18 and 20 and the inner diameter of the shells 22 allow the clip 10 to securely clamp on the rod 11.

The second side of the clip body 12 can include, but is not limited to, a short hemi-cylinder rod (Clip 10A, Figure 2), a laterally extending hemi-cylinder rod with a plurality of vertical teeth (Clip 10B, Figures 3-4), a second pair of mirror image hemi-cylindrical shells (Clip 10C, Figures 8-9), a laterally extending rod tapering from a proximal cylindrical shape to a distal hemi-cylinder shape (Clip 10D, Figure 12), or an outwardly extending U-shaped receptacle designed to receive a semi-cylindrical or cylindrical rod and a locking cap device (Clip 10E, Figures 15-16). Each of these embodiments will be described below.

One embodiment of the transverse connector clip 10A is shown in Figure 2. Here, the clip body 12 consists of a first side 14 as previously described (Figure 1) and a second side 16 that comprises a preferably short laterally extending hemi-cylinder rod 40, however, any shaped rod could be utilized. The short hemi-cylinder rod 40 integral to the second side 16 of clip body 12 is shaped to facilitate installation of clip 10A by a user. A user can use the short rod 40 to manually engage and disengage the clip body 12 from a cylindrical rod 11 of two rods joined together in a spinal fixation system. Clip 10A can be used to connect transverse connector clips having laterally extending hemi-cylinder rods 10B (Figure 6). One advantage of the inventive connector clip 10A over prior art connectors is that clip 10A is a single piece connector, thereby reducing the amount of assembly of the spinal fixation system required by prior art connectors during surgery.

Another embodiment of the present invention is the transverse connector clip 10B (Figure 3). Here, the clip body 12 consists of a first side 14 as previously de-

scribed (Figure 1) and a second side 16 that includes a laterally extending hemi-cylinder rod 50 having a first side 52, a second side 54, and a longitudinal axis LA1-LA1. However, other shapes can be utilized for the laterally extending hemi-cylinder rod 50. The first side 52 contains a plurality of vertically placed teeth 56 extending along the longitudinal axis LA1-LA1. Figure 4 shows a perspective view of the second side 54 of connector clip 10B.

Clip 10B is designed to be interlocked to a second clip 10B (Figure 5). The first sides 52 of the hemi-cylinder rods 50 are connected to each other via the plurality of vertical teeth 56 extending along the longitudinal axes LA1-LA1 of the hemi-cylinder rods 50. The clips 10B can transversely connect two longitudinal rods 11 placed at varying distances from each other with the plurality of teeth 56 accommodating the variable distance. This variable distance is indicated by the lateral motion arrows LM1-LM1 (Figure 5). This ability of the clips 10B provides a significant advantage during surgery where many such adjustments are necessary to fine tune the alignment of the assembly in the patient.

The connection between clips 10B can be maintained by using transverse connector clip 10A (Figure 6). When the first sides 52 of the hemi-cylinder rods 50 are engaged by the interlocking of the plurality of vertical teeth 56, the second sides 54 form a cylindrical rod having a diameter that is slightly larger than the inner diameter 22 defined by the inner surface 24 of the hemi-cylindrical shells 18 and 20 of clip 10A. Thus, the hemi-cylindrical shells 18 and 20 of clip 10A can snap onto the connected hemi-cylinder rods 50 of clips 10B as if the connected hemi-cylinder rods 50 were a single cylindrical rod 11.

While Figure 6 illustrates a transverse connector clip 10A of the present invention connecting the laterally extended hemi-cylinder rods 50 of clips 10B, it should be understood that any connecting device known to one skilled in the art can be used to connect the hemi-cylinder rods 50. The advantage of using the transverse connector clip 10A of the present invention, however, is that it consists of a single piece which facilitate surgery by reducing the number of pieces that need to be assembled.

The spinal rod assembly using transverse connector clips 10A and 10B of the present invention connects to longitudinal rods 11 that are connected to a human vertebrae 91 as schematically shown in Figure 7. Two cylindrical rods 11 are each connected to a transverse connector clip 10B through the mirror image hemi-cylindrical shells 18 and 20. The laterally extending hemi-cylinder rods 50 of clips 10B are connected to each other by the interlocking of the plurality of vertical teeth 56. This connection is maintained by clip 10A.

Clip 10C (Figures 8-9) is an alternate embodiment of the transverse clip connector 10 having a clip body 12 with a first side 14 and a second side 16. The first side 14 is as previously described (Figure 1). The second side 16 of the clip body 12 comprises a second set of mirror image hemi-cylindrical shells 60 and 62. Like the hemi-cylindrical shells 18 and 20 on the first side 14 of clip body 12, hemi-cylindrical shells 60 and 62 can be placed on the second side 16 of the clip body 12 as shown (Figure 8) or in mirror image relationship (not shown).

The second set of hemi-cylindrical shells 60 and 62 have an outer surface 64 and an inner surface 68. The inner surface 68 defines a rod bore 70 through which a cylindrical rod 88 can extend. Rod bore 70 has a diameter 72 that is slightly smaller than the diameter of the rod 88 it is designed to receive.

Clip 10C is designed to simultaneously connect two longitudinal rods 11 and a transverse rod 88 together. The cylindrical rods 11 connect to the first side 14 of the clip body 12 as previously described. Cylindrical rod 88 connects to the second side 16 of clip body 12 in a similar fashion. Namely, clip body 12 is placed on a cylindrical rod 88 at 90 degrees and turned so that the hemi-cylindrical shells 60 and 62 spread around the rod 88. The deflection of the hemi-cylindrical shells 60 and 62 and the inner diameter 72 allow the clip body 12 of clip 10C to securely clamp on the rod 88.

One advantage of having the second side 16 of the inventive clip body 12 comprising a second pair of hemi-cylindrical shells 60 and 62 is that it allows attachment of this second pair of shells 60 and 62 to various other rod types used in spinal surgery such as T-bar 80 (Figure 10) and an I-bar (not shown). A T-bar 80 and an I-bar can horizontally bridge a pair of cylindrical rods 11 (Figure 11) significantly strengthening the spinal fixation system.

T-bars 80 have a longitudinal body 82, a first end 84 and a second end 86. The first end 84 of T-bar body 82 has a cylindrical-shaped bar 88 perpendicularly connected to the T-bar body 82 (Figure 10). This bar 88 can be connected to the second pair of hemi-cylindrical shells 60 and 62 of invention clip 10C as described above.

Two inventive clips 10C can be used to connect two cylindrical rods 11 via two T-bars 80 (Figure 11). In this example, two clips 10C are each connected to bars 88 on the first ends 84 of two separate T-bar bodies 82. The second ends 86 of each T-bar body 82 is then connected to each other via a tapered locking sleeve 90 or by any means known to those of skill in the art. The relative placement of one cylindrical rod 11 to the other can be adjusted by adjusting the T-bar connection as indicated by circular motion arrows CM1-CM1 and CM2-CM2. In this way, the inventive clips 10C can facilitate the creation of the desired transverse bridge between two cylindrical rods 11 using a minimum number of pieces.

While the embodiment shown here (Figure 11) shows invention clips 10C connected to two different T-bars 80, it should be understood that two clips 10C can also be connected to the opposite ends of a single I-bar (not shown). An I-bar has a longitudinal body and a first

and second end. The first end has a first rod-shaped bar positioned perpendicular to the I-bar body. The second end has a second cylindrical-shaped bar positioned perpendicular to the I-bar body. The first pair of hemi-cylindrical shells 18 and 20 of clip 10C is connected to a first cylindrical rod 11 while the second pair of hemi-cylindrical shells 60 and 62 is connected to the first bar on the first end of the I-bar body. A second invention clip 10C is connected to a second cylindrical rod 11 through hemi-cylindrical shells 18 and 20 and then to the second bar on the second end of the I-bar body via hemi-cylindrical shells 60 and 62. In this way, the I-bar provides a horizontal bridge between two cylindrical rods by connection via the invention clips 10C.

In another embodiment of the inventive clip 10, the first side of the clip body 12 is as previously described, while the second side of the clip body 12 comprises a laterally extending rod 100 having a first side 102, a second side 104, a longitudinal axis LA1-LA1, and a proximal 106 and distal 108 end (Clip 10D, Figure 12). The proximal end 106 is cylindrical in shape and tapers to a hemi-cylindrical shape at the distal end 108.

Clip 10D is designed to connect to another clip 10D (Figures 12-14) via the laterally extending tapering rods 100. The laterally extending tapered rods 100 are connected to each other by mating the first sides 102 together. This connection can be maintained with any of the devices known to those of skill in the art including, but not limited to, a tapered locking sleeve 90. This tapered locking sleeve 90 consists of an inner 92 and outer 94 sleeve portion. Inner sleeve portion 92 has an inner surface 96 and outer surface 98; and outer sleeve portion 94 has an inner surface 110 and outer surface 112 . The outer surface 98 of the inner portion 92 has a diameter 114 slightly smaller than a diameter 116 of the inner surface 110 of the outer sleeve 94 so as to allow the inner sleeve portion 92 to be placed concentrically inside the outer sleeve 94 in order to lock the inner sleeve portion 92 and outer sleeve portion 94 together.

To assemble clips 10D, the outer sleeve portion 94 is positioned on a laterally extending hemi-cylinder bar 100 of a first connector clip 10D and the inner sleeve portion 92 is positioned on a laterally extending hemi-cylinder bar 100 of a second connector clip 10D (Figures 12-14). The first sides 102 of the laterally extending hemi-cylinder bars 100 of the first and second clips 10D are mated and held in locking engagement by the tapered sleeve 90.

The distance between the two connector clips 10D can be laterally adjusted by moving the laterally extending tapered rods 100 as indicated by the arrows LM2-LM2 in Figure 13. When the first sides 14 of each clip body 12 of clips 10D are connected to two different cylindrical rods 11 via the hemi-cylindrical shells 18 and 20 on the first side 14 of the clip body 12 (Figure 14), lateral adjustment of the tapered rods 100 laterally adjusts the relative position of the cylindrical rods 11 to which the connector clips 10D are connected. This provides the user with some flexibility in adjusting the alignment of the cylindrical rods 11 in a spinal fixation apparatus during surgery.

A spinal rod assembly using connector clips 10D and a tapered locking sleeve 90 connects to longitudinal rods 11 that are connected to a human vertebrae 91 as schematically shown in Figure 14. Two cylindrical rods 11 are each connected to a clip 10D through the mirror image hemi-cylindrical shells 18 and 20. The laterally extending tapered bars 100 of clips 10D are held together with a tapered locking sleeve 90. The assembly of the tapered locking sleeve 90 is also shown.

Several means of clamping the various types of laterally extending rods from the second side 16 of the invention clip body 12 have been described above including another transverse clip of the present inventive clip 10A (Figure 6) and a tapered sleeve 90 (Figures 12-14). However, it should be understood that laterally extending hemi-cylinder rods can be connected by any other connecting means known to one skilled in the art

In yet another embodiment of the inventive transverse connector clip 10, the first side 14 of the clip body 12 is as previously described, while the second side 16 of the clip body 12 comprises an outwardly extending rod holding portion 120 and a locking mechanism 130. The rod holding portion has a longitudinal axis positioned perpendicular to the longitudinal axis LA1-LA1 of the first side 14 of the clip body 12. The locking mechanism 130 is configured to engage with the rod holding portion 120 in order to locking the longitudinal rod into the rod holding portion 120. The rod holding portion can be in the shape of a solid holding portion having a through bore for receiving a hemi-cylindrical or cylindrical rod and the locking mechanism can be of any locking mechanism known to one skilled in the art, such as tapered locking caps, set screws or locking nuts. In one embodiment, the holding portion is a U-shaped holding portion 120 having a longitudinal axis LA3-LA3 positioned perpendicular to the longitudinal axis LA1-LA1 of the first side 14 of connector clip 10E (Figures 14-15). The U-shaped holding portion 120 has an upper portion 122 and a lower portion 124. The lower portion 124 is configured to receive a flat side 126 of a hemi-cylindrical rod 128. Alternatively (not shown), the lower portion 124 of the U-shaped portion 120 can be configured to receive a cylindrical rod 11. A locking mechanism for the U-shaped portion 120 can indude a locking cap 130 with an upper 132 and lower side 134 configured to slide into and mate with the upper portion 122 of U-shaped portion 120. Upper side 132 of locking cap 130 has a tapered portion 136 that engages and mates with a tapered pordon 138 in the upper portion 122 of the U-shaped portion 120. The lower side 134 of the locking cap 130 is configured to accommodate an arcuate side 140 of the hemi-cylindrical rod 128.

The advantage of the inventive clip 10E, when used in combination with the locking cap 130, the hemi-cylinder support bar 128, and cylindrical rod 11 (figure 15-16)

is that connecting clip 10E is a single piece that connects two rods together, thus reducing the requirement of the prior art connectors to assemble small pieces of hardware during the surgical procedure.

It should be understood that in keeping with spinal surgery techniques, a plurality of cylindrical rods 11 can be used, each with a plurality of attachment devices affixed thereto, with the present attachment devices transversely connecting either two rods 11 together or connecting portions of rods together in other alignments.

The foregoing disclosure and description of the invention are illustrative and explanatory thereof, and various changes in the details of the illustrated apparatus and construction and method of operation may be made without departing from the spirit of the invention.

Claims

1. A device for connecting two elongated spinal rods to one another in a spinal fixation system comprising:

   a clip body including a first portion and a second portion, the first portion of the clip body configured to receive and engage a first elongated spinal rod, the second portion of the clip body having a transverse bore therein for receiving a second elongated spinal rod extending transverse to the first elongated spinal rod; and
   a locking member dimensioned and configured for mounting in the transverse bore in the second portion of the clip body so as to fix the position of the second elongated spinal rod with respect to the first elongated spinal rod.

2. A device as recited in Claim 1, wherein the first portion of the clip body includes a pair of opposed spaced apart arcuate rod engaging hooks for receiving and engaging the first elongated spinal rod.

3. A device as recited in any of the preceding claims, wherein each arcuate rod engaging hook defines a curve having a common central axis.

4. A device as recited in any of the preceding claims, wherein the second elongated spinal rod has a generally semi-circular transverse cross-section for reception by the lower portion of the U-shaped opening.

5. A spinal fixation system comprising:

   a first elongated spinal rod having a first transverse cross-section;
   a second elongated spinal rod having a second transverse cross-section different than the transverse cross-section of the first elongated spinal rod; and
   a connector having a first portion configured to engage the first elongated spinal rod and a second portion configured to engage the second elongated spinal rod, the first portion and the second portion so configured such that the first spinal rod and the second spinal rod are oriented transverse to one another.

6. A spinal fixation system as recited in 5, wherein the first elongated spinal rod has a circular transverse cross-section and wherein the second elongated spinal rod has a generally semi-circular transverse cross-section.

7. A spinal fixation system as recited in any of the preceding claims, wherein the second elongated spinal rod includes a planar surface for contacting a substantially planar surface of the second portion of the connector.

8. A spinal fixation system as recited in any of the preceding claims, wherein the connector defines a clip body including a first portion and a second portion, the first portion of the clip body having a pair of opposed spaced apart arcuate rod engaging hooks depending therefrom configured to receive and engage the first elongated spinal rod, the second portion of the clip body having a transverse bore extending therethrough configured to receive the second elongated spinal rod.

9. A spinal fixation system as recited in any of the preceding claims, further comprising a locking member dimensioned and configured to mount within the transverse bore in the second portion of the clip body so as to fix the position of the second elongated spinal rod with respect to the first elongated spinal rod.

10. A spinal fixation system as recited in any of the preceding claims, wherein the transverse bore is defined at least in part by a generally U-shaped opening having a pair of spaced apart side walls and a substantially planar lower portion extending between the side walls.

11. A spinal fixation system as recited in any of the preceding claims, wherein each side wall has a tapered engagement slot formed therein, and the locking member includes a top portion and a bottom portion, the bottom portion having a pair of opposed tapered retention members each for engaging a respective one of the tapered engagement slots in the side walls, and a hemi-cylindrical groove in a bottom surface thereof for accommodating a portion of the second elongated spinal rod.

12. A spinal fixation system as recited in any of the preceding claims, wherein the top portion of the locking member includes a pair of opposed supplemental retention members spaced from the opposed tapered retention members on the bottom portion.

13. A spinal fixation system comprising:

a first clip body having a pair of opposed spaced apart arcuate rod engaging hooks depending from a first side thereof for engaging a first elongated spinal rod, and a transverse connector extending laterally from a second side thereof;
a second clip body having a pair of opposed spaced apart arcuate rod engaging hooks depending from a first side thereof for engaging a second elongated spinal rod, and a transverse connector extending laterally from a second side thereof; and
a fastener for securing the transverse connector of the first elongated clip body and the transverse connector of the second elongated clip body to one another.

14. A spinal fixation system as recited in Claim 13, wherein the transverse connector extending from the first clip body and the transverse connector extending from the second clip body have complementary cross-sectional configurations such that together the pair of transverse connectors define a circular cross-section.

15. A spinal fixation system as recited in any of the preceding claims, wherein the fastener is defined by a third clip body having a pair of opposed spaced apart arcuate engaging hooks,

16. A spinal fixation system as recited in any of the preceding claims, wherein the fastener is defined at least in part by a cylindrical compression sleeve.

17. A spinal fixation system as recited in any of the preceding claims, wherein the transverse connector extending from the first clip body and the transverse connector extending from the second clip body have complementary mating surfaces.

18. A spinal fixation system as recited in any of the preceding claims, wherein the complementary mating surfaces are substantially planar and wherein the complementary mating surfaces have interlocking teeth formed thereon.

19. A spinal fixation system as recited in any of the preceding claims, wherein each elongated clip body has a second pair of opposed arcuate engaging hooks depending from a second side thereof, and the transverse connector includes a perpendicular rod portion for reception by the second pair of arcuate engaging hooks.

20. A spinal fixation system comprising:

a first clip body having a first pair of opposed spaced apart arcuate engaging hooks depending from a first side thereof for engaging a first elongated spinal rod, and a second pair of opposed spaced apart arcuate engaging hooks depending from a second side thereof for engaging an elongated transverse connector; and
a second clip body having a first pair of opposed spaced apart arcuate engaging hooks depending from a first side thereof for engaging a second elongated spinal rod, and a second pair of opposed spaced apart arcuate engaging hooks depending from a second side thereof for engaging the elongated transverse connector.

21. A spinal fixation system as recited in Claim 20, wherein the elongated transverse connector includes a first rod portion at a first end thereof for engaging the second pair of opposed arcuate engaging hooks on the first clip body and a second rod portion at a second end thereof for engaging the second pair of opposed arcuate engaging hooks on the second clip body.

22. A spinal fixation system as recited in Claim 20 or 21, wherein the elongated transverse connector includes a first elongated portion and a second elongated portion, the first and second elongated portions connected to one another by a fastener.

23. A spinal fixation system comprising:

an elongated spinal rod;
a transverse member; and
a connector having a pair of opposed spaced apart arcuate rod engaging hooks for receiving and engaging the elongated spinal rod, the connector securing the elongated spinal rod and the transverse member in a transverse orientation in which the elongated spinal rod and transverse member are substantially coplanar.

24. A spinal fixation system as recited in Claim 23, wherein the connector has a transverse bore therein for receiving transverse member.

25. A spinal fixation system as recited in Claim 23 or 24, further comprising a locking member dimensioned and configured for mounting in the transverse bore of the connector so as to fix the position of the transverse member with respect to the elongated spinal rod.

26. A spinal fixation system as recited in Claim 23 or 25, wherein the transverse member comprises an elongated rod having a generally semi-circular transverse cross-section.

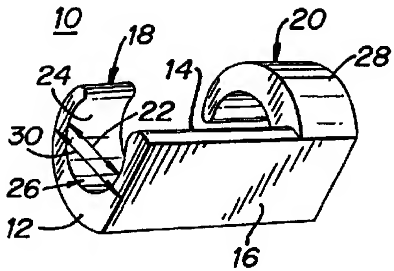


FIG_1

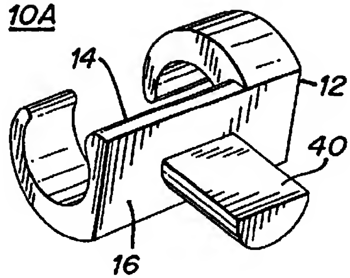


FIG_2

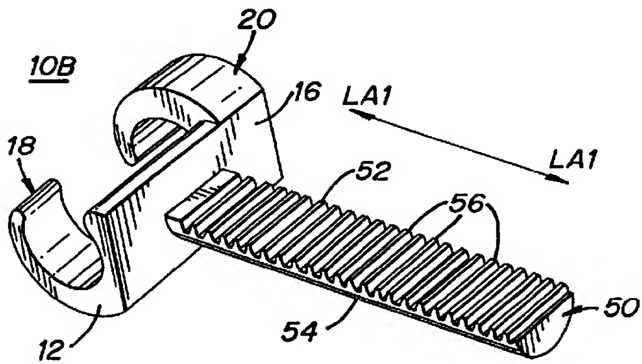


FIG_3

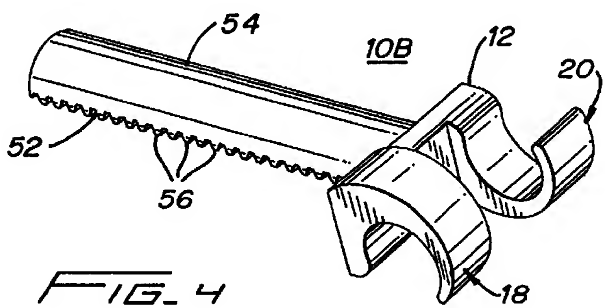


FIG_4

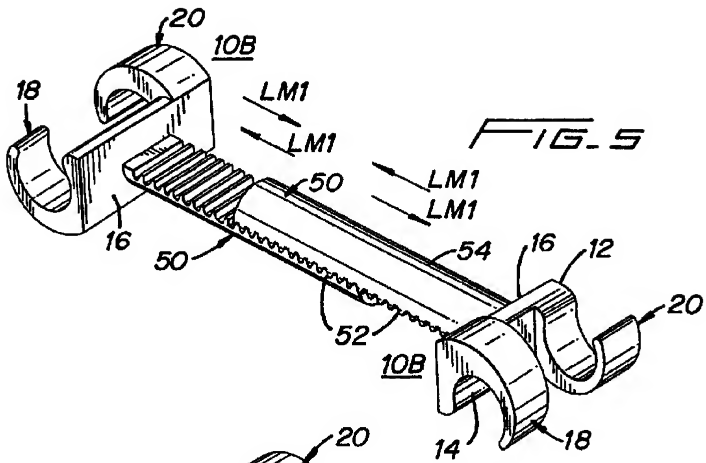


FIG_5

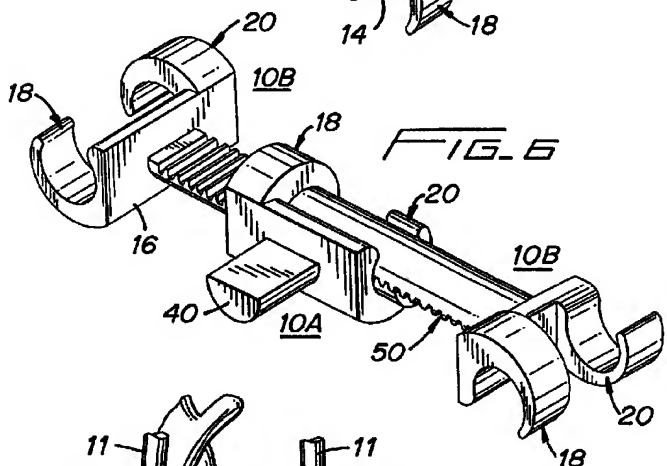


FIG_6

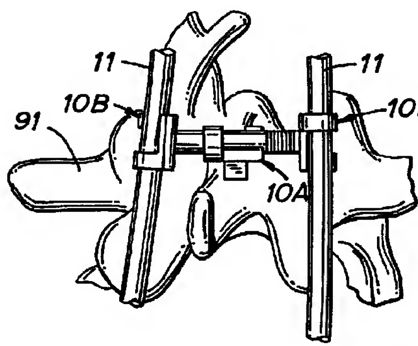


FIG_7

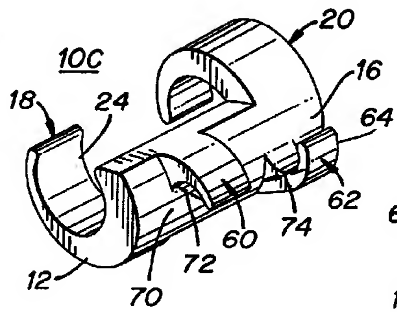


FIG. 8

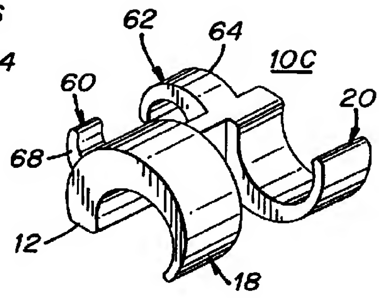


FIG. 9

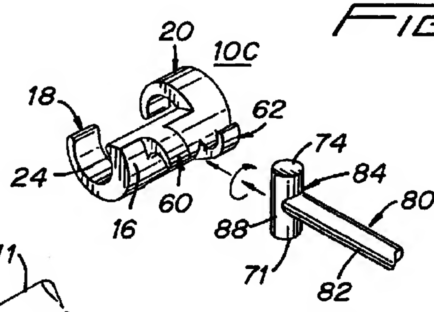


FIG. 10

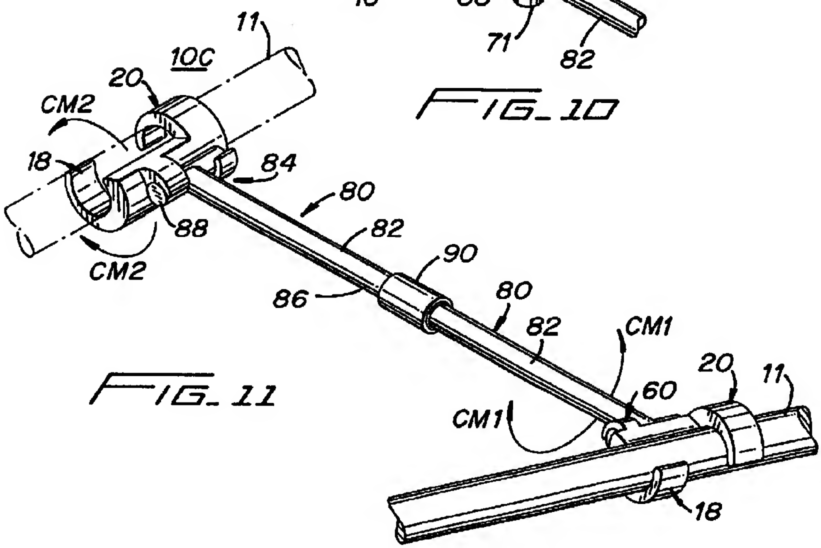


FIG. 11

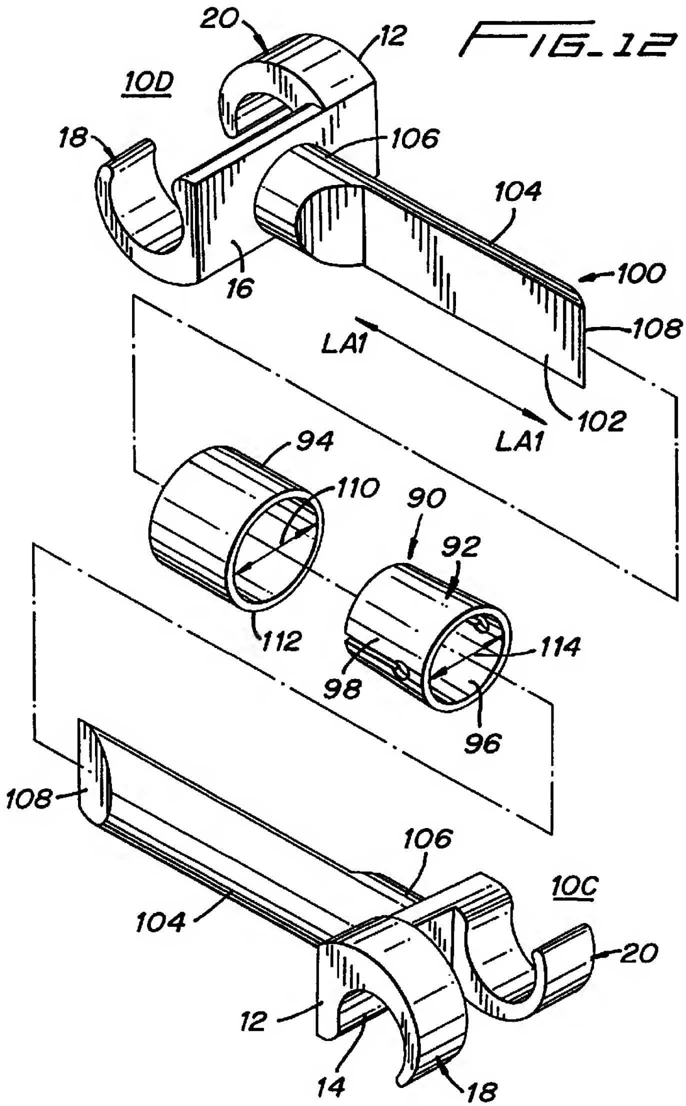

20
12
10D
18
106
104
16
100
108
LA1
LA1
102
94
110
90
92
112
114
98
96
108
106
10C
104
20
12
14
18

FIG_12

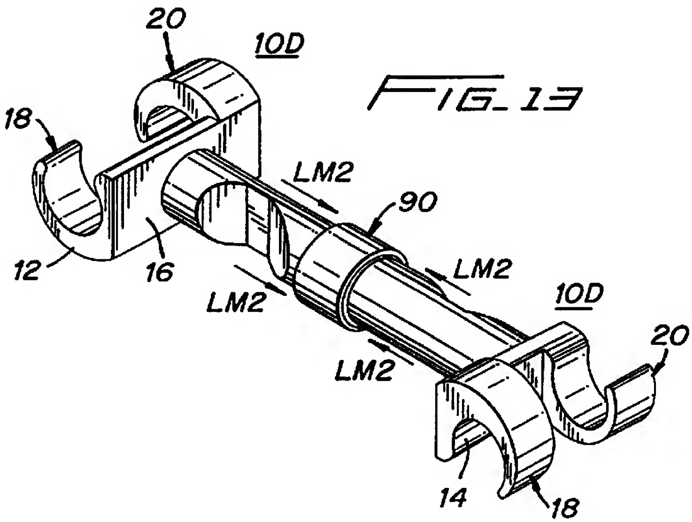
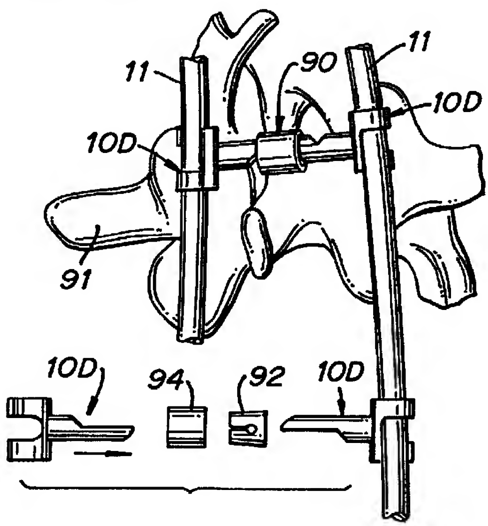

20
10D
18
LM2
90
12
16
LM2
LM2
10D
20
LM2
14
18

FIG_13

FIG_14


11
90
11
10D
10D
91
10D
94
92
10D

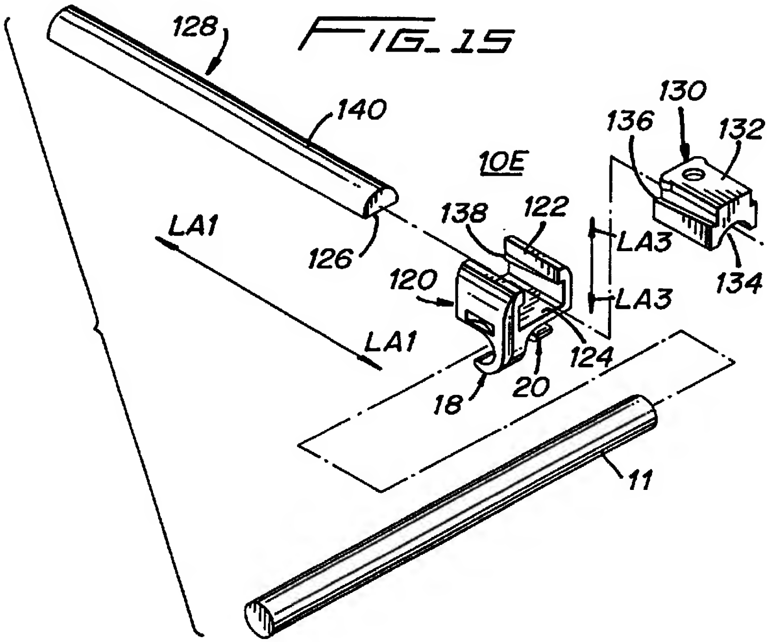
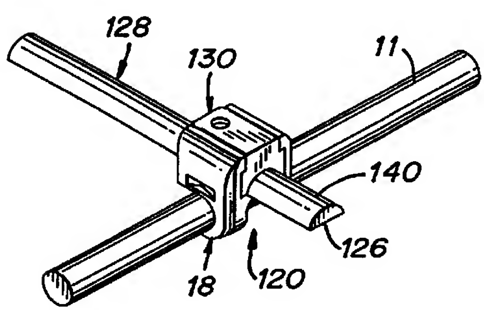

128
140
10E
130
136
132
138
122
LA1
LA3
126
120
LA3
134
LA1
124
18
20
11

FIG_15


128
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11
140
126
18
120

FIG_16